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Shelving the Gender Patent Gap

There is much to read and even more to hear about why a gender gap in wages and executive privilege exists. The historical and societal forces that produce these workplace inequities might offer, as well, one explanation for what is referred to as the "gender patent gap," the disparity in the percentage of United States patents (government-granted rights that protect inventors' work from being copied or sold by others) awarded to men as compared to the percentage awarded to women. Available data show that 7.5 percent of all United States patents are awarded to women and only 5.5 percent of commercialized patents are licensed by women (Hunt et al. 1).

However, scholarly thought as to the forces that perpetuate the patent gap is varied and, to some extent, has produced seemingly contrary conclusions. This paper will present some of the conflicting research as well as additional evidence to support one of the theories. To begin, though, it might be helpful to consider why innovation is important, how patents encourage innovation, and how history has treated women innovators.

In his book *Innovation and its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It*, Brandeis University Economics Professor Adam B. Jaffe writes that innovation leads to social benefits such as longer and healthier lives, rising incomes, and more numerous consumer choices for a population. Therefore, he says, "it is in our collective interests to create social, cultural, and legal institutions that foster technological innovation" (42). Jaffe notes that because technological innovation is

capital-intensive, “the incentive to invest in research and development must come, ultimately, from an expectation of making a bunch of money if the thing pans out” (43). To that end, the government grants patents, which convert the innovator’s intangible creation into “property that can be bought and sold, or upon which a business can be founded” (Jaffe 41). The government uses its legal system to provide remedies to innovators whose proprietary ideas or products are made, used or sold by others. Juries decide the penalty (usually a significant amount of money) that a patent “infringer” must pay to the patent awardee as compensation for the violation.

So patents protect the economic investments made in research and development, but they also protect the career interests of the researchers and inventors. Patents are the ultimate indicator of innovation and engineering success, and in the working world of invention, no patent equals no opportunity for career advancement (Rosser Intro). Unfortunately, the patent process in the United States makes it even more difficult for a woman to find her name on an award for three reasons. First, the United States Patent and Trademark Office (USPTO) has not issued a report covering patenting by women since its 1998 publication “Buttons to Biotech.” This lack of information makes gauging the width or narrowness of the gender patent gap difficult. Second, patent applications, devised by the USPTO, do not provide an opportunity for the patent applicant to indicate his or her sex. To date, the most accurate method of determining the sex of a patent holder is to make an educated guess based on the first name provided on the patent application (Vargo-Smith 1). Third, following a policy change made by the USPTO in September 2012, the award of a patent is now made to the first filer, not the first inventor. The disadvantage here is that a project leader, rather than a collaborative group that might or might not include one or more women, receives credit for the patent.

In the introduction to her essay, “Examining Exclusion in Woman-Inventor Patenting: A Comparison of Educational Trends and Patent Data in the Era of Computer Engineer Barbie®,”

former director of the Science and Technology Law Center at Albany Law School Annette I. Kahler includes a brief overview of the obstacles American women have encountered in the pursuit of patents. Many of the historical roadblocks she cites are understood also to be the basis for wage disparity between the sexes: no property rights, no educational opportunities, no or limited monetary resources, and societal condemnation if a woman left her "home." Other obstacles included a lack of legal remedy in the event a woman *did* invent something. In such a case, her husband would secure the patent, then sell and keep any profits made from the invention and she would be unable to benefit (Kahler 780). Kahler also believes that women in 19th century America were discouraged from pursuing the higher education required to enter the fields of engineering and science, and, therefore, also discouraged from embarking on careers as inventors because of societal attitudes that the demands placed on their bodies might create reproductive difficulties (781).

Today, as in the 19th century, an obvious correlation can be made between a low number of patent awards made to women and a low number of women in the fields of physical science and engineering. But today, unlike in the 19th century, women seem to be pursuing the education that should lead to careers in Science, Technology, Engineering and Mathematics (STEM) fields. United States Bureau of Labor Statistics (USBLS) data indicate that in 2011 women made up approximately 15 percent of the engineering and physical sciences workforce. Although this percentage of representation by women is much higher than in certain broad, traditionally male-dominated employment fields (i.e., in the construction industry, 2.3 percent of the workforce is female), it is lower than the percentage of women leaving college with qualifying STEM degrees. The American Society for Engineering Education (ASEE) data show that for the 2010-11 academic year, women earned 18.4 percent of all undergraduate engineering

degrees (USBLS 13), 22.7 percent of all engineering master's degrees (20), and 21.8 percent of all engineering doctorates (24).

The difference between the percentage of STEM degrees granted and the percentage of women finding employment in engineering or physical science illustrates that some other obstacles are keeping women from careers in fields of patentable innovation. Some researchers today observe that there are numerous women embarking on careers in physical science or engineering, but then exiting the field. Still others maintain that a sufficient number of women are employed as engineers, but that they are not in jobs that can lead to patentable projects.

Not enough female engineers

In a March 2012 podcast on NPR's Marketplace about the enormous disparity in patent awards to men compared to women, one of the experts interviewed by host Kai Ryssdal, Alison Booth from the Department of Economics at Australian National University, suggested that women choose not to enter STEM fields because of what she describes as women's inherent risk aversion. She said her research indicates that women avoid risky behavior (in the study, Booth segregated women from men and observed the women's willingness to participate in activities that involved gambling) when they interact with men, but engage in risky behavior when they are in single-sex environments (Booth, Sosa, and Nolen 18). Booth's research was not conducted with the intent of furthering the understanding of why women do not enter STEM careers, nor was she researching patent award inequality. She was studying risk aversion, but projected her conclusions about gambling propensity on to gender inequity with regard to patent awards as part of the podcast discussion.

Booth's research indicating that women are risk averse supports an argument made by Sue V. Rosser that women might turn away from careers in engineering because they have less interest in money than do men and so might shun commercialized science. Although Rosser uses

the term “risk averse” to refer to women potentially being uncomfortable with financial transactions, she frames this discomfort as stemming from some women’s objection to “selling their science” or giving their research investment over to capitalism (Rosser 78).

Another study done in an attempt to explain the perceived low number of women entering physical science and engineering fields suggests that young girls are not given sufficient or accurate information in the early years of their education. Marywood University researcher Lou Jean Beishline interviewed female undergraduate engineering majors at three United States universities about the decision process the students went through prior to declaring a major. The young women indicated that their secondary school teachers and guidance counselors supported their decision to go into the field of engineering, but that they (the teachers and counselors) were not able to accurately convey what undergraduate study or careers would entail. Although the lack of adequate information did not deter the students from declaring an engineering major, other female students with whom they were acquainted decided against pursuing an engineering degree. Beishline’s interviews also indicated that a high percentage of the young women experienced or recognized unintentional inequities when they were in their grade school and high school math and science classrooms; for example, not being called on to solve problems or explain concepts. They said their teachers most often selected boys in the class to provide solutions and answers. Beishline believes these biases discourage female students from entering college engineering or physical science programs (Beishline 32).

Kahler believes the main reason women with engineering degrees choose to not work in the field is because of persistent stereotypes. She cites a study that indicates most adults and many young women think engineering/technology is a specialized field that is “not for everyone, especially not for women.” When describing their strengths compared to young men’s strengths, the young women responded that they were strong communicators, and that men were strong

"techies" and creators (Kahler 794). These stereotypes, Kahler notes, are deep-rooted and not likely to change (797). She recommends that different types of studies be conducted to identify factors that draw the small percentage of women who do seek careers in engineering or physical science. Data collected from such studies could then be used to devise strategies to increase the number of women enrolled in physical science and engineering majors (Kahler 798).

Another explanation for the low number of women in invention fields is the influence that parents exert over their daughters through gendered thinking. Beishline's study also investigated the female undergraduate engineering students' childhood home life. She found that stereotyped gendered thinking by a girl's parents discouraged the pursuit of an engineering career by conveying the expectations associated with engineering in a burdensome way. This might be expressed through parental concerns about the intense workload of the engineering profession or the limits such a career would place on a woman's ability to raise children and care for a home (Beishline 32).

Plenty of engineers, not enough staying power

University of Memphis researchers Yonghong Jade Xu and Cynthia Martin are among those scholars who maintain that there are sufficient numbers of women entering college engineering or physical science programs, but that the women exit the field because the workplace is competitive and does not foster professional socialization and networking. Yonghong and Martin are particularly interested in the value and effectiveness of informal professional networks (IPNs), which are the work-related and/or social relationships established in workplaces. They found that men expect their IPNs to offer collaborative benefits as well as foster competition. Women, on the other hand, did not expect their IPNs to be competitive (Yonghong and Martin 147). Yonghong and Martin suggest the lack of peer solidarity leads to many workplace frustrations for women, including restricted access to critical information;

subjection to stereotyping in evaluations; fewer opportunities for advancement; and less social, professional and administrative support (135).

Yonghong and Martin's work parallels that of Stanford University professor of psychology Anne Peterson, whose research indicates that despite unfilled engineering jobs and increased numbers of women earning STEM degrees, as much as 50 percent of women leave the engineering workplace. She attributes the attrition to women's frustration with the culture of commercialized science — where competition is the rule, rather than teamwork and co-operation. Such an environment creates both the "pushes" of isolation as well as the "pulls" of other, less-competitive career fields, and Peterson views this dynamic as the main reason women voluntarily leave the fields of invention (Santovec 24).

Rosser attributes the exit of women from engineering and the physical sciences to ... lack of patents. She believes attrition can be seen at every phase of a woman's journey through the STEM life, beginning in universities where most innovation is supposed to occur. This is especially damaging, she says, because "few women obtaining patents hurts scientific innovations, technology and competitiveness overall" (Rosser 67), but because patenting is integral to technology and science firms, women literally cannot succeed (Rosser 71). This lack of success drives the downward spiral because the venture capitalists behind commercialized science might not back the projects of a non-patented female inventor (Rosser 78).

Plenty of engineers doing the wrong job

Jennifer Hunt, a professor in the Department of Economics at Rutgers University, also believes there are enough women engineers and scientists on the job, but she believes the patent gap would be much narrower if those women were working at jobs that could lead to patents. The most patented fields in the United States are electrical and mechanical engineering, but women who are employed in those fields are not leading projects and, therefore, not eligible to

file for patent awards. Hunt's research data and models suggest that merely increasing the number of women working in STEM fields would have little effect on narrowing the patent gap because 78 percent of the gap can be explained by women holding the wrong degree specialization. Further, Hunt says, as electrical or mechanical engineers, women need to work in the design or development of projects in order to have an opportunity to apply for patents (Hunt 13).

Hunt's contention seems plausible. ASEE data from the 2010-11 academic year indicate that 7 percent of electrical and mechanical engineering degrees were awarded to women. Recall that presently 7.5 percent of all patents awarded go to women. If all women engineers – a total of 13.25 percent of the engineering and physical sciences workforce – earned their degrees in either electrical or mechanical engineering and entered the workforce, technological advances and the patent awards in STEM would likely increase from 7 percent to around 24 percent. She believes the impact of technology development at this pace would create an increase of 2.7 percent of annual per capita GDP (Hunt 13).

The challenge of commercial science

Several of the researchers cited believe that the commercialization of science has had an effect on women's career choices and/or opportunities. Rosser thinks that women might not be comfortable with the idea of doing "beneficial" research and then delivering that innovation into the capitalist economic system; Peterson thinks the competitive nature of commercial research keeps women from entering STEM fields. Rosser and Peterson might be correct in their notions, but against the backdrop of commercial science and *its* patents, the issue of award disparity along gender lines seems almost trivial.

As Jaffe noted, conceptually, patents create "property" ... upon which a business can be founded. Conceptually, patents are doing their job. The National Science Foundation's 2006

"Patents Granted to Americans" report shows 71 percent of U.S. patent awards were assigned to corporations whose "employee inventors" collect a paycheck rather than collecting rights to a licensing contract. This ratio might be conservative, however, because a 2011 study by Kahler suggests as much as 90 percent of U.S. patents are awarded to corporations (777). Patents seem to be corporate growth vehicles as well as legal protection for research investment.

The Journal of Neural Engineering, created to "help scientists, clinicians and engineers to understand, replace, repair and enhance the nervous system," published an editorial in 2008 encouraging its readers to conduct research while keeping an eye out for investment — that is, business startup — opportunities:

> In recent years, there have been several successful spinoffs of neurotechnology startup firms that originated with research at universities and clinical institutions. In many cases, the academic researchers who invented the new technology or product innovation have stayed on with their startup firms after receiving funding from venture capital firms, or after going public. (Cavuoto 1)

Government-funded research, whether it takes place in university labs or corporate science centers, uses public money, which is then moved to the private realm through the patent process. The end result is that tax dollars pay for the work that corporations use to secure patent awards and, therefore, future profits. Again, from the *Journal of Neural Engineering* editorial:

> ... (keep in mind) several factors that would influence a neurotech startup's market potential, such as identifying the regulatory pathway, any predicate devices that exist, and the revenue potential for potential investors. (Cavuoto 2)

Conclusion

The absence of good, reliable patent data combined with conflicting schools of thought on the likely causes of patent award disparity between the sexes in the United States makes it

likely that a solution for or resolution of the “patent gap” will not soon come. It seems pointless to push this issue any further, however, because the bigger problem is the fact that commercial science has commandeered the patent machine, and left independent innovators — women and men alike — in its wake.

Works Cited

Primary Source:

Ryssdal, Kai. (2012, March 25). Marketplace. *Closing the Gender Gap in Patent Filing.* Podcast retrieved from http://www.marketplace.org/topics/life/freakonomics-radio/closing-gender-gap-patent-filing.

Secondary Sources:

American Society for Engineering Education. *Engineering College Profiles and Statistics*. Washington, D.C., (2012): 11-47. Print.

Beishline, Lou Jean. *"Perceptions of Women in Engineering Programs Regarding Parental Influence on Academic Choice: A Qualitative Study."* Diss. Marywood University, 2008.

Booth, Alison, Lina Cardona Sosa, Patrick Nolen. "Gender Differences in Risk Aversion: Do Single-Sex Environments Affect Their Development?" *Working Paper 6133. Australian National University* (2011): 1-56. JSTOR. Web. 30 Oct. 2012.

Cavuoto, James. "Commercial Opportunities for Neural Engineers." *Journal of Neural Engineering* 5 (2008): 1-2. Print.

Hunt, Jennifer, Jean-Philippe Garant, Hannah Herman, David J. Munroe. "Why Don't Women Patent." *Working Paper 17888. National Bureau of Economic Research* (2012): 1-27. JSTOR. Web. 9 Nov. 2012.

Hunt, Jennifer. "Why Do Women Leave Science and Engineering." *Working Paper 15853. National Bureau of Economic Research*. (2010): 1-43. JSTOR. Web. 9 Nov. 2012.

Jaffe, Adam B. *Innovation and Its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What to Do About It*. Princeton, NJ: Princeton University Press, 2004. Print.

Kahler, Annette I. "Examining Exclusion in Woman-Inventor Patenting: A Comparison of Educational Trends and Patent Data in the Era of Computer Engineer Barbie®." *The American University Journal of Gender, Social Policy and the Law* 19.3 (2011): 773-98. Print.

Yonghong, Jade Xu, and L. Martin Cynthia. "Gender Differences in STEM Disciplines: From the Aspects of Informal Professional Networking and Faculty Career Development." *Gender Issues* 28.3 (2011): 134-54. Print.

Rosser, Sue, V. "The Gender Gap in Patenting: Is Technology Transfer a Feminist Issue?" *NWSA Journal* 21.2 (2009): 65-84. Print.

Santovec, Mary, Lou. "Understanding the Culture of Science is Key to Success." *Women in Higher Education* 18.1 (2010): 23-25. Print.

Smith-Vargo, Linda. “From Image to Invention.” *Creative Woman* 13.3 (1993): 13-15. Print.
United States. Bureau of Labor Statistics. *Household Data Annual Averages.* Washington: GPO (2012): 1-11. Print.